

REMARKS

Claims 1 through 4 are pending in this application. Reconsideration is requested based on the foregoing amendment and the following remarks.

Objections to the Specification:

The Specification has been objected to for using reference numeral 4 for two different parts. Ozone generator 4 has consequently been renumbered ozone generator 5 at page 7, line 4 of the specification. Withdrawal of the objection is earnestly solicited.

Claim Rejections - 35 U.S.C. § 112:

Claims 3 and 4 were rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which is not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The rejection is traversed.

The Office action asserts that the disclosure does not indicate whether ammonium hydroxide is taken in solid form or has been dissolved and what concentration the solution may be. To the contrary, claims 3 and 4, which are supported by the specification at, inter alia, page 4, lines 23-25, recite simply,

“forming a cleaning solution by adding ozone to aqueous ammonium hydroxide, which is composed of ammonium hydroxide and deionized water in the volume ratio of 0.001 - 0.01 : 5.” Neither claim 3 nor claim 4 mention dissolving the ammonium hydroxide in anything at all before forming aqueous ammonium hydroxide by mixing 0.001 - 0.01 volume of ammonium hydroxide per five volumes of deionized water. Claims 3 and 4, rather, recite only aqueous ammonium hydroxide, which is composed of ammonium hydroxide and deionized water in the volume ratio of 0.001 - 0.01 : 5. Those of skilled in the art would therefore understand that ammonium hydroxide could be pure, or it could be dissolved in something, so long as the volume of *ammonium hydroxide* relative to the volume of deionized water recited in claims 3 and 4 is met substantially. It is submitted therefore that those of skill in the art would be able to make and use the invention by, inter alia, forming aqueous ammonium hydroxide by mixing 0.001 - 0.01 volume of ammonium hydroxide per five volumes of deionized water. Withdrawal of the rejection is earnestly solicited.

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Claims 3 and 4 were rejected under 35 U.S.C. § 112, second paragraph, as indefinite.
The rejection is traversed.

The Office action asserts that it is not clear whether ammonium hydroxide is taken in solid form or has been dissolved and what concentration the solution may be. To the contrary, claims 3 and 4, recite simply,

“forming a cleaning solution by adding ozone to aqueous ammonium hydroxide, which is composed of ammonium hydroxide and deionized water in the volume ratio of 0.001 - 0.01 :5.”
Neither claim 3 nor claim 4 mention dissolving the ammonium hydroxide in anything at all before forming aqueous ammonium hydroxide by mixing 0.001 - 0.01 volume of ammonium hydroxide per five volumes of deionized water. It is submitted that those of skill in the art would be able to make and use the invention by, inter alia, forming aqueous ammonium hydroxide by mixing 0.001 - 0.01 volume of ammonium hydroxide per five volumes of deionized water. Withdrawal of the rejection is earnestly solicited.

Claim Rejections - 35 U.S.C. § 103:

Claim 3 was rejected under 35 U.S.C. § 103 as being unpatentable over Fukazawa, US 6,423,146. The rejection is traversed. Reconsideration is earnestly solicited.

1. Summary of Fukazawa:

- 1) Preparation step: Ozone water (0-20 ppm) supply to cleaning chamber for oxidation of silicon surface;
- 2) Cleaning step: cleaning solution (mixture of ozone water and NH_4OH , 0.5 ~ 5 wt% NH_4OH) supply to cleaning chamber => etching of oxide, cleaning and reduction of surface micro roughness;
- 3) Pure water supply to cleaning chamber: rinse step.

2. Cleaning mechanism of Fukazawa:

Surface oxidation by ozone water => oxide etching by cleaning chemical (ozone water + NH_4OH) => rinse by pure water.

3. Differences between Fukazawa and the claimed invention:

- 1) Oxidation mechanism: In Fukazawa, a silicon surface is oxidized by ozone water before cleaning. This oxide layer is then etched by ammonium hydroxide in a cleaning solution. If the silicon surface is treated with the cleaning solution proposed by Fukazawa without the

pretreatment, the silicon surface will be roughened by severe etching due to high concentration of NH_4OH . So, in Fukazawa, pretreatment in ozone water is necessary for surface oxidation.

In the claimed invention, on the other hand, a silicon surface may be oxidized by direct treatment in a cleaning solution (a mixture of ozone and NH_4OH) because NH_4OH is diluted sufficiently. In a very diluted NH_4OH solution, ozone can be dissolved in an alkaline solution and an oxidizing radical is generated by reaction between ozone and NH_4OH , and then the silicon surface can be oxidized by the dissolved ozone and these radicals. Therefore, in the claimed invention, pretreatment of the silicon surface is unnecessary.

2) Prevention of surface roughness:

In Fukazawa, surface roughness can be reduced by the surface oxidation of silicon surface by ozone water. If the pretreatment step of silicon surface is skipped, the roughness of silicon surface will be increased by direct etching in NH_4OH solution. The pretreatment step is a key process for prevention of surface roughness. It should be also mentioned that the concentration of ozone at Fukazawa's NH_4OH concentration is nil. Severe etching of silicon surface is to be expected without pretreatment.

In the claimed invention, on the other hand, roughness is not induced by NH_4OH because NH_4OH is markedly diluted and ozone is dissolved in this solution. So, the diluted NH_4OH solution and the dissolved ozone are key factors for prevention of surface roughness.

3) NH_4OH concentration:

In Fukazawa, ozone in DIW is 0 ~ 20 ppm and concentration of NH_4OH is 0.1 - 5 wt%, and ozone is rapidly decomposed. In this case, cleaning efficiency is not up to expectation.

4) Cleaning Mechanism:

In Fukazawa, particles can be removed by oxidation step in ozone water and etching step in cleaning solution (NH_4OH + ozone water). In Fukazawa, the cleaning step is composed of two steps.

In the claimed invention, on the other hand, particles can be removed by oxidation reaction with dissolved ozone and oxidizing radicals and then etching reaction with NH_4OH combined with Megasonic. In the claimed invention, the cleaning step is just a single step.

Claim 3 recites, in pertinent part:

"supplying the cleaning solution into a cleaning bath through a filter for removing ozone

bubble."

Fukazawa neither teaches, discloses, nor suggests supplying the cleaning solution into a cleaning bath through a filter for removing ozone bubble, as recited in claim 3. The Office action takes Official Notice that filters are known. Even if filters are known separately, however, there is no teaching or suggestion in Fukazawa of the necessity of using a filter in combination with the other elements of claim 3, nor is there any reason one would have read Fukazawa as *not* promising a reasonable expectation of success *without* a filter.

Furthermore, the Office Action provides no motivation or suggestion to modify Fukuzawa as required by 35 U.S.C. § 103(a) and the M.P.E.P. §706.02(j)(D). There is no evidence in Fukuzawa that cavitation was even established by the ultrasound, let alone that it was anything less than efficient, contrary to the Office action. It is submitted, therefore, that taking Official Notice is not justified in this case. The Applicant requests respectfully some evidentiary support for the assertion in the Office action that it would have been obvious at the time of the invention to modify Fukuzawa as proposed by the Office action.

A *prima facie* case of obviousness requires (1) a suggestion or motivation to modify the reference or combine reference teachings, (2) a reasonable expectation of success, and (3) that the cited prior art reference(s) teach or suggest all the claim limitations. See M.P.E.P. § 2143. The rejection based on Fukuzawa does not constitute a *prima facie* case of obviousness, because Fukuzawa does not teach or suggest supplying the cleaning solution into a cleaning bath through a filter for removing ozone bubble, and there is no suggestion or motivation to modify the method described in Fukuzawa to do so.

Furthermore, whether similar filters may be separately known (although no evidence in support of this assertion is cited) is not sufficient to establish a *prima facie* case that the *combination* of elements recited in claim 3 would have been obvious to persons of ordinary skill in the art at the time the invention was made.

If identification of each claimed element not found in the prior art by taking of Official notice were sufficient to negate patentability, the Office action could use the claimed invention itself as a blueprint for piecing together elements to defeat the patentability of the claimed invention. To prevent the use of hindsight based on the teachings of the patent application, the Office Action must show a motivation to modify the references in the manner suggested.

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Absent a hindsight reconstruction of the invention claimed herein, there is no "teaching, suggestion, or motivation" to modify Fukuzawa as proposed by the Office action.

Claim 3 recites further,

"dipping a wafer surface in the cleaning solution which is at a room temperature to remove contaminants on the wafer surface."

Fukazawa neither teaches, discloses, nor suggests supplying the cleaning solution into a cleaning bath through a filter for removing ozone bubble, as recited in claim 3. The Office action assumes that cleaning temperature is a result effective variable, and then asserts that discovery of an optimum value of a result effective variable is ordinarily within the skill in the art.

There is no teaching, suggestion, or indication in Fukuzawa that cleaning temperature is a result effective variable with respect to surface roughness. An assumption that persons of ordinary skill in the art who read Fukuzawa the time the invention was made would have believed cleaning temperature is a result effective variable with respect to surface roughness is submitted to be unwarranted. It is submitted, rather, that persons of ordinary skill in the art who read Fukuzawa for all it contained at the time the invention was made would not have gleaned the slightest inkling that cleaning temperature is a result effective variable with respect to surface roughness, let alone concluded that cleaning temperature ought to be optimized. The Applicant requests respectfully some evidentiary support for the assertion in the Office action that cleaning temperature is a result effective variable with respect to surface roughness, and that it would have been obvious at the time of the invention to modify Fukuzawa as proposed by the Office action. Claim 3 is submitted to be allowable. Withdrawal of the rejection of claim 3 is earnestly solicited.

Claim 4 was rejected under 35 U.S.C. § 103 as being unpatentable over Fukazawa in view of JP2000-164552. The rejection is traversed. Reconsideration is earnestly solicited.

Claim 4 recites, in pertinent part:

"supplying the cleaning solution into a cleaning bath through a filter for removing ozone bubble."

Fukazawa neither teaches, discloses, nor suggests supplying the cleaning solution into a cleaning bath through a filter for removing ozone bubble, as discussed above with respect to claim 3. JP2000-164552 doesn't mention a filter at all, and thus cannot make up for the

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deficiencies of Fukuzawa with respect to claim 4. Since neither Fukuzawa nor JP2000-164552 teach, disclose, or suggest supplying the cleaning solution into a cleaning bath through a filter for removing ozone bubble, their combination cannot, either. Thus, even if Fukuzawa and JP2000-164552 were combined as proposed in the Office action, the claimed invention would not result.

Claim 4 recites further:

"supplying the cleaning solution into the cleaning bath again along the circulation pipe through a chiller."

Neither Fukuzawa nor JP2000-164552 teach, disclose, or suggest supplying the cleaning solution into the cleaning bath again along the circulation pipe through a chiller, contrary to the assertion in the Office action. Since neither Fukuzawa nor JP2000-164552 teach, disclose, or suggest supplying the cleaning solution into the cleaning bath again along the circulation pipe through a chiller separately, their combination cannot, either. Even if, therefore, Fukuzawa were combined with JP2000-164552 in the manner proposed by the Office action, the claimed invention would not result.

Furthermore, the Office Action provides no motivation or suggestion to modify Fukuzawa as required by 35 U.S.C. § 103(a) and the M.P.E.P. §706.02(j)(D). Fukuzawa indicates no necessity of increasing a concentration of ozone in a cleaning solution at column 3, lines 15-19, contrary to the assertion in the Office action. Fukuzawa, rather, states that the concentration of ozone in the ozone water *can* be increased up to approximately 20 ppm at column 3, lines 14 and 15. That is, the process of Fukuzawa will tolerate a concentration of up to 20 ppm, not that a high concentration is necessary. It is submitted, therefore, that persons of ordinary skill in the art who read Fukuzawa at the time of the invention would not have concluded that a high concentration of ozone is necessary at all, contrary to the assertion in the Office action.

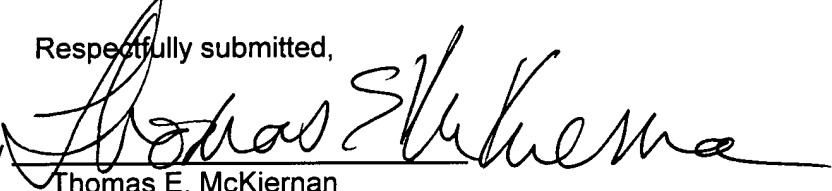
Furthermore, JP2000-164552 says nowhere that in order to increase ozone concentration in cleaning media such media should be cooled at 15 ° C or below, contrary to the assertion in the Office action. JP2000-164552, rather, merely mentions in passing that the pure water *may* be cooled before mixing with ozone at a high concentration. It is submitted, therefore, that persons of ordinary skill in the art who read JP2000-164552 at the time of the invention would not have concluded that in order to increase ozone concentration in cleaning

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media such media should be cooled at 15 ° C or below, contrary to the assertion in the Office action. Claim 4 is thus submitted to be allowable, for at least the same reasons given above with respect to claim 3. Withdrawal of the rejection of claim 4 is earnestly solicited.

Conclusion:

Accordingly, in view of the reasons given above, it is submitted that both of claims 3 and 4 are allowable over the cited references. Since the objections to the specification were addressed as well as the rejections based on 35 U.S.C. § 112, first and second paragraphs, it is submitted that both of claims 3 and 4 are now allowable. Allowance of both of claims 3 and 4 and of this entire application are therefore respectfully requested.

Respectfully submitted,

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